XXX. *Remarks on the very different Accounts that have been given of the Fecundity of Fiſhes, with freſh Obſervations on that Subject: By Mr.* Thomas Harmer; *communicated by* Samuel Clark, *Eſq; F. R. S.*

Read May 28, 1767.

THE aſcertaining the fecundity of the ſeveral ſpecies of fiſh, as far at leaſt as we are able to do it, is one point neceſſary to the making our natural hiſtories perfect; and at the ſame time opens a view wonderfully affecting to the imagination.

The carp, in which Petit is ſaid to have found 342,144 eggs; and the cod, in one of which of middling ſize Lewenhoek, it ſeems, affirmed there were 9,384,000, have been mentioned as very ſurprizing inſtances of this fecundity; and by their being ſelected by writers, who appear to have been well verſed in this part of learning, they ſhould ſeem to be the moſt memorable we have of this kind.

The accounts, however, that have been given of the fruitfulneſs of theſe two ſpecies of fiſh differ from each other very conſiderably. For Bradley, the Botanic Profeſſor at Cambridge ſome years ago, tells us in his philoſophical account of the works of nature, a book profeſſedly written on a very celebrated, though unexecuted plan,

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plan *, that the increaſe in ſome fiſh is ſurprizing, and to thoſe that are not uſed to diſquiſitions of this kind muſt appear incredible; he however ſinks the number of eggs in theſe two ſpecies extremely, when he tells us the roe of a cod-fiſh muſt contain about a million of eggs, and that a carp does not ſpawn leſs than 20,000, to which he adds, and perhaps a tench half as many. This is making the cod almoſt ten times leſs prolific than the other account, and the carp above ſeventeen times leſs. Some other writers, who appear alſo to have been deſirous to impreſs the mind with the wonders of natural hiſtory, have made their eſtimate ſtill lower. One of them, I remember in particular, in one of our monthly publications, from whence numbers muſt take their ideas, who have no opportunity of reading more authentic accounts elſewhere, tells us, that carp and perch have nine or ten thouſand eggs, and that cod-fiſh, and herring, are not leſs prolific; and this he calls wonderful. The increaſe of cod-fiſh is indeed, even according to this, very great, but almoſt a thouſand times leſs than Lewenhoek is ſaid to have found it.

Their accounts being ſo very different, I thought I ſhould not improperly employ ſome leiſure hours, if I inquired into this matter afreſh, and ſaw what the fecundity of theſe ſpecies of fiſh really was, as well as of ſuch other ſorts as might fall in my way; and eſpecially as I had found that a ſmall pickerel, whoſe ſpawn I had taken a pretty exact account of, from mere curioſity, ſome time before, contained no fewer than 25,800 eggs: a fiſh which

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* Propoſed by Mr. Addiſon in one of the Spectators.

none of theſe authors had mentioned, and of which notwithſtanding a ſmall one had produced a larger number of eggs than Bradley himſelf had aſſigned to the carp, which has been always looked upon as remarkable for its prolific quality, not to mention the unknown writer, who makes its fecundity much leſs.

The make of my eyes, which are much leſs proper for diſtinguiſhing objects at a diſtance, than the ſeeing ſmall things that are near; and my living in a maritime country, and though not near the ſea, yet in a ſituation which I thought very proper for the procuring ſuch fiſh as I wanted, were additional motives to the ſearch: though as to the laſt particular, I have ſince found myſelf greatly diſappointed.

It will not be imagined, that, in order to aſcertain the real number of eggs in each fiſh which I examined, I told them all over one by one; this would have been, if not abſolutely impracticable, at leaſt inconſiſtent with other engagements, and much more fatiguing than was neceſſary. My way was to weigh the whole ſpawn very exactly; then to take a piece weighing twenty, thirty, or forty, or more grains, as was moſt convenient, and after weighing that parcel with care, and giving the turn of the ſcales to the weights, not to the eggs, to tell them over very carefully; and then by dividing the number of eggs by the grains, to find how many eggs there were in each grain, or nearly ſo. I ſay nearly, for there muſt, according to this method, have been rather more; but I choſe to eſtimate them after this manner, that there might be no danger of repreſenting the fecundity of theſe animals greater than the truth

truth. I frequently boiled the portions of ſpawn that I told, and after macerating them ſome hours in water, gently preſſed them with a penknife, whoſe point I afterwards made uſe of to number them diſtinctly, by ſeparating them from each other to greater diſtances, after they were rendered by that gentle ſqueezing fitter for telling over.

In ſeveral fiſh I found their eggs of very different ſizes. In ſuch caſes my rule was, to tell all I could diſtinguiſh by my naked eye, and thoſe only; though I have often found, by the help of an eye-glaſs, that, by thus limiting myſelf, I paſſed over great multitudes of eggs that might juſtly have been counted *. I generally told them on a fine earthen

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* For, though they were very different in ſize, they were all, I preſume, to be depoſited in the proper places for hatching that ſeaſon, though it may be not on the ſame day, ſince after fiſh are ſhotten, as it is called, we find no eggs at all in them. I think I do not by any means take upon me to affirm, that all fiſh depoſite their eggs after this manner, *i. e.* by degrees, and at times a little diſtant from each other; but ſome ſpecies of them, I ſhould think it is plain, do. This is the caſe of ſtickleback in particular, in which, when they have been extremely diſtended with ſpawn, I have found ſeveral eggs very large, but ſeveral hundreds very ſmall, and many of them too ſmall to be counted diſtinctly by an unaſſiſted eye, which ſmaller ones could never, I apprehend, grow to the ſize the larger ones had grown to before the larger ones were excluded. I have ſeen ſome of theſe eggs ſo large, that 24 or 25 would weigh a grain; about which ſize, I believe, they are excluded, ſince ſome of that bulk came away from one of thoſe creatures after it was taken out of the water, and were found in the paper in which it was wrapped up: but generally upon opening theſe fiſh they are not quite ſo large, though very large in compariſon of many of the reſt. I told in one of theſe ſmalleſt of fiſhes, which weighed very little more than 14 gr. ſpawn and all, about 936 eggs, ſome of which almoſt eluded my eye, beſides

veſſel,

veſſel, which was extremely black, by which means I could much better diſcern them, than I otherwiſe ſhould have been able to do. The weights I have reckoned by are Avoirdupois weights; but there being no weights of that ſort ſmall enough to anſwer all purpoſes, I was obliged to make uſe of grains along with them, of which I reckon 437½ make an ounce Avoirdupois. After this manner I made the obſervations of which I am going to give an account, with all the nicety and care I was capable of.

I begin with the herring, which makes a diſtinguiſhed figure in theſe two counties of Norfolk and Suffolk, and a conſiderable part of our commerce, when ſalted and ſmoked. One of the above-mentioned authors ſuppoſed, they may have 9 or 10,000 eggs: of ſeveral I examined, I found none which had ſo few as 20,000; and in one I found 36,960. The intermediate numbers which appeared to me on

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numbers of others that I could not tell at all. Thoſe that I told were of all ſizes; and though there were but 56 very large eggs, yet the creature was extremely diſtended. Now it does not appear poſſible that all the 936 eggs ſhould grow to the bulk of the largeſt of their companions without deſtroying the fiſh, ſince the growing of 56 to ſuch a ſize as to weigh about 1½ grain diſtended it in ſuch a manner as I have hardly ſeen in any other ſpecies of fiſh. In ſome very large ſticklebacks, which weighed 45 or 50 grains, I have found between 2 and 300 of theſe large eggs, along with great numbers of ſmaller ones, ſo that the number of large eggs ſeems to bear ſome proportion to the ſize of the fiſh, by which means a greater number of eggs, anſwerable to their ſize, may be depoſited in the ſame time in which the ſmaller fiſh of this ſpecies diſcharge their leſs numerous ſpawn. I will only farther obſerve here, that if this be the caſe as to the other fiſh, the number of their eggs may, on this account, appear very different to different obſervers.

examination, may be met with in a table that I ſhall place at the end of this paper, which will give the particulars relating to this ſort of fiſh, and ſeveral others, in the ſhorteſt manner, but with ſufficient diſtinctneſs.

The next that came under my inſpection was the ſmelt. Theſe, it is well known, are a very ſmall ſort of fiſh, and are frequently uſed for garniſh to thoſe that are larger. In one of theſe, which did not weigh quite two ounces, I found 38,272 eggs; and in none ſo few as 20,000; excepting one, which was extremely ſmall, not weighing above 289½ grains, in which very ſmall fiſh I found 14,411. This was amazing.

I was much more ſurprized, when, after this, I learnt what was the fecundity of mackarel. This no author that I met with gave an account of, though it is a fiſh ſo extremely common. In one large fiſh of this kind, weighing ſomewhat better than 1¼℔, I found 454,961 eggs; in a ſecond, of much the ſame weight, 430,846; and in a third, which weighed but about 1℔ 2oz. I found 546,681.

I was aſtoniſhed upon this, that Bradley ſhould call the ſuppoſed fecundity of carp, which he makes to be but about 20,000, ſo ſurprizing; or that even Petit's obſervation, which made it appear, that in ſome fiſh of that ſpecies the eggs amount to 342,144, ſhould cauſe the carp to be ſelected as the moſt extraordinary fiſh for increaſe, after the cod, when it appears to be ſo much greater in mackarel (which is at the ſame time ſo common a fiſh), as to be not much ſhort of the proportion of 5 to 3, in the laſt I examined.

I ſhall leave it to the table at the cloſe, to give an account of the prolific quality of ſome other fiſh, whoſe eggs I have counted, and ſhall paſs on to what I have found in the carp, which ſpecies Petit examined. As to this fiſh, though I cannot ſay I have found the eggs, in thoſe that have come under my notice, ſo numerous as he did; yet, as I have found the number much larger than Bradley mentions, ſo I make no doubt but that Petit really found them amount to 342,144; and I would add, that I dare ſay they may be found to be much more numerous ſtill in large fiſh of this kind, ſince in one that I examined, weighing but 16¾ oz. I found 101,200; and in another, which weighed no more than 25½ oz. I found 203,109, and carp grow to a much larger ſize than the biggeſt of theſe, but I could not procure any of thoſe large carp that were full of ſpawn.

If I failed in verifying Petit's number of eggs in a carp, I found thoſe of a tench to exceed it, more than once, which Bradley reckons not to produce more than half the number a carp does, or 10,000. For I found in one tench, which weighed 2½ ℔, 383,252 eggs at leaſt; and in another that weighed not quite 1¾ ℔, 350,482.

As to perch, which one of thoſe authors I mentioned puts upon a par with carp, I could get none of any ſize. The largeſt, which weighed but 8 oz. 9 dr. contained 28,323 eggs; and a ſecond of 5 oz. 10 dr. had in it 20,582. They ſeem, however, to be much leſs prolific, in proportion to their bulk, than tench, ſince the largeſt of theſe had but about 28,323 eggs, and I found a tench of nearly that ſize, weighing but 8 oz. 14¾ dr. produced 83,104.

Bradley ſeems to have been as careful not to be guilty of exaggeration with reſpect to the cod-fiſh, as in the other caſes. He eſtimates them at a million, while Lewenhoek affirmed that he found above nine millions of eggs, in one of middling ſize. The ſpawn of one of that ſize which I examined, that is to ſay, one of 18 or 20lb weight, I found to contain between three and four millions, if my friend's weights were accurate, for I made the examination at a diſtance from home; and by a ſubſequent obſervation at home, I have reaſon to think there was this number in it, though I was prevented purſuing my ſecond examination ſo far as I would have done, by ſome particular occurrences. According to this, there is nothing incredible in Lewenhoeck's account; his fiſh, I ſuppoſe, being remarkably diſtended with ſpawn, and for that reaſon perhaps thought, by that inquiſitive and curious perſon, a ſubject that ought not to paſs unexamined.

I have hitherto mentioned no flat fiſh, nor do I remember that any author has given us an account of their fecundity. I imagined, from their make, it could not be extraordinary; I was therefore extremely ſurprized to find in the firſt flounder I examined and which did not weigh quite three ounces, 133,407 eggs; in a ſecond, which weighed little more than $3\frac{1}{2}$ ounces, 225,568; and much more ſtill when I diſcovered in a large one, that weighed about $24\frac{1}{4}$ oz. and which was of that ſort that is ſpotted like a plaiſe, as Ray has told us ſome flounders are, 1,357,400: this was truly aſtoniſhing.

The number of eggs that a ſoal produces, I have obſerved to be great, but nothing like that which I

found

found in flounders, finding in one, which did not fall much ſhort of a pound, rather more than 100,000; and in another, that weighed about five ounces, 38,772.

To make this diſquiſition ſtill more extenſive, I examined two or three kinds of ſhell-fiſh. I found in a lobſter of 14½ oz. when in the ſhell, and of 10¼, when diveſted of it, 7,227; and in another that weighed 2¼ ℔, and out of the ſhell ſomewhat better than 1¾ ℔, I told 21,699 eggs.

I took alſo the pains to tell all the eggs of ſome ſhrimps, one by one, and found in one which weighed 17½ grains only, 3057; in another of 31 gr. 4090; and in a third of 39 gr. 6807.

This, conſidering the ſmallneſs of the creature, is more remarkable than the fruitfulneſs of the lobſter; but neither is the one or the other to be compared, in this reſpect, to the crab, for in a large one, weighing near 1¼ ℔, but not quite, I found that the ſpawn weighed 687 gr. but the eggs were ſo minute, and at the ſame time adhered ſo cloſe together, that I could not number them diſtinctly; however, the weight of the whole, and the minuteneſs of the eggs, ſhow that they muſt have been very numerous; and I believe from a rough eſtimate I made, that they exceeded a million.

The table, at the cloſe, gives all theſe accounts, with the addition of ſeveral more particulars, in a very ſhort compaſs. The firſt column contains the names of the fiſh which I examined; the ſecond their weight; the third the weight of their ſpawn; the fourth their fecundity; and, as I ſuppoſed ſome perſons might be deſirous to know how large a portion

portion of ſpawn I weighed in each caſe, I have ſet down the number of grains in each ſuch portion, in a fifth; the number of eggs found in a grain, by this method is ſeen in a ſixth, by which we may give ſome gueſs at the different ſizes the eggs of each ſpecies are of, when they are excluded; and I have made the time of examining each fiſh reſpectively a ſeventh; which poſſibly may be of ſome uſe to thoſe who may have an inclination to repeat any of theſe obſervations, as from thence may be learnt ſomething concerning the moſt advantageous time of examining theſe creatures, which certainly ought to be as nearly as we can, when the eggs are come to their full ſize, and before any of them are depoſited. However, after all, if my notion is juſt, that ſome ſpecies depoſit a part of their eggs come to their full growth, before others laid the ſame year are big enough to be told with diſtinctneſs, the accounts of the fecundity of ſuch fiſh muſt be extremely defective; and this I apprehend, amongſt thoſe I have examined, is the caſe of mackarel, carp, tench, and ſome others; in herring,&c. there does not appear ſuch a difference in the ſize of different eggs.

From this table it appears, that the ſize of the eggs is nearly the ſame in great and ſmall fiſhes of the ſame ſpecies, at the ſame time of the year; that the quantity of ſpawn is, uſually, nearly proportionate to the ſize of the animal, from whence we may give a tolerable gueſs at the greateſt fecundity of each ſpecies, if we know to what weight they have been found to grow while in a breeding ſtate; we may likewiſe ſettle their produce at a medium, upon learning what is the mean ſize of each ſpecies when

when in the forementioned ſtate, but we ſee, however, that this is not univerſal, nor conſequently perfectly exact, ſome fiſh being much more prolific than others of the ſame ſize, and ſpecies.

To conclude, the great fecundity of fiſh is not the only thing that affects the imagination, when we are examining matters of this ſort: the extreme diſproportion between their ſize when they firſt appear in the water after hatching, and that of their full-grown ſtate, as well as the little proportion that is to be obſerved between the bulk of fiſh of different ſpecies and that of their eggs, are things that are very amazing to perſons of a curious turn. The egg of a ſmelt, which at its full growth weighs but two or three ounces, appeared, in thoſe I examined, to be larger than thoſe of a cod-fiſh, which weighed eighteen or twenty pounds, and might have grown to double that bulk; and that of a ſtickleback, which is the ſmalleſt of all known fiſh, was found to be above ſix times bigger than the largeſt I ever obſerved in a ſmelt. What becomes of ſuch amazing numbers of young fiſh, and why ſome are made ſo extremely prolific, the flounder and crab in particular among the ſmaller ſorts, would doubtleſs be highly entertaining ſubjects, if duly illuſtrated; but theſe are enquiries I have no opportunity of making.

The TABLE.

1. Names of the fiſh.		2. Their weight	3. Weight of the ſpawn	4. Fecundity	5. The portion of ſp. weighed	6. N°. of eggs to a grain	7. Time of exam.
		oz. dr.	grains.		grains.		
Carp	N°. 1	16 12	1265	101.200	46	80	May 25
	N°. 2	25 8	2571	203.109	55	79	April 4
Cod-fiſh		———	12.540	3.686.760	29	294	Dec. 23
Flounder	N°. 1	2 14	182½	133.407	23	731	Feb. 21
	N°. 2	3 8½	152	225.568	19	1484	Dec. 18
	N°. 3	6 12	598	351.026	26¾	587	March 14
	N°. 4	24 4	2.200	1.357.400	24½	617	d°.
Herring	N°. 1	4 3	367	32.663	48	89	Oct. 8, 1763
	N°. 2	5	236½	21.285	48½	90	29
	N°. 3	3 13	259	23.569	52½	91	Oct. 2, 1764
	N°. 4	5 10	480	36.960	53	77	25
	N°. 5	4 6½	366	29.646	57	81	d°.
	N°. 6	4 8	420½	27.753	51	66	Nov. 3
	N°. 7	5 1	490½	32.863	41½	67	Oct. 18
Lobſter	N°. 1	14 8	———	7227	———	14	April 4
	N°. 2	36 0	1671	21.699	129	———	Aug. 11
Mackarel	N°. 1	20 —	1027	454.961	33	443	June 20, 1764
	N°. 2	20 —	949	430.846	24½	454	29
	N°. 3	18 —	1223½	546.681	32½	447	18, 1765
Perch	N°. 1	8 9	765½	28.323	85	37	April 5
	N°. 2	5 10	502	20.582	85	41	6
Pickerel	N°. 1	56 4	5100½	49 304	70	9⅔	April 25
	N°. 2	———	3248	80.388	76½	24¾	Nov. 25
	N°. 3	48 10½	3184	33.432	43	10½	March 19
Prawn	N°. 1	(127 gr.)	———	3.806	———	243	May 12
	N°. 2	(94½ gr.)	———	3.479	———	287	d°.
	N°. 3	(100½ gr.)	———	3.579	———	247	d°.

1. Names of the fiſh.		2. Their weight		3. Weight of the ſpawn	4. Fecundity	5. The portion of ſp. weighed	6. N°. of eggs to a grain	7. Time of exam.
		oz.	dr.	grains.		grains.		
Roach (or what I took to be of that ſpecies)	N°. 1	2	—	114	9.604	—	—	April 4
	N°. 2	6	8	671	43.615	68	65	May 4 1764
	N°. 3	3	8	$346\frac{1}{2}$	29.799	$42\frac{1}{2}$	86	d°.
	N°. 4	2	2	153	9.486	$42\frac{1}{2}$	62	5
	N°. 5	10	$6\frac{1}{2}$	361	81.586	39	226	2 1765
	N°. 6	9	$10\frac{3}{4}$	417	113.841	42	273	6
	N°. 7	3	8	$213\frac{1}{2}$	45.475	20	213	24
Shrimp (with light coloured ſpawn.)	N°. 1	($17\frac{1}{2}$ gr.)		3	3.057		1000	May 3
	N°. 2	(39 gr.)		7	6.807		972	d°.
	N°. 3			—	4.601		—	d°.
Ditto (with dark colour)	N°. 1	(31 gr.)		5	4.090		818	d°.
	N°. 2	(22 gr.)		4	2.849		712	d°.
Smelt	N°. 1	2	—	$149\frac{1}{2}$	38.278	30	256	Feb. 21
	N°. 2	($289\frac{1}{2}$ gr.)		50	14.411	—	288	Mar. 21, 1764
	N°. 3	1	14	$157\frac{1}{2}$	29.925	$40\frac{1}{2}$	190	27, 1765
	N°. 4	1	12	$145\frac{1}{2}$	30.991	20	213	28
	N°. 5	1	7	149	24.287	20	163	d°.
	N°. 6	1	5	136	23.800	20	175	d°.
Soal	N°. 1	14	8	$542\frac{1}{4}$	100.362	20	185	June 13
	N°. 2	5	—	$179\frac{1}{2}$	38.772	20	216	28
Tench	N°. 1	40	—	—	383.252*	—	—	May 28, 1764
	N°. 2	28	8	$533\frac{1}{2}$	280.087	25	525	3, 1765
	N°. 3	8	$14\frac{3}{4}$	224	83.104	20	371	10
	N°. 4	9	8	$284\frac{1}{2}$	108.963	20	383	d°.
	N°. 5	12	8	366	138.348	$22\frac{1}{4}$	378	d°.
	N°. 6	27	$9\frac{1}{2}$	1969	350.482	23	178	June 11
	N°. 7	14	15	866	138.560	20	160	d°.

* N°. 1. of the tench certainly had a much larger number of eggs; but being extremely diſtended with ſpawn, and unluckily let fall before it was brought to me, the enveloping ſkin in which the eggs were contained was broke, which made it difficult to determine ſome circumſtances relating to this fiſh; it however had the number of eggs I have ſet down, at the loweſt way of reckoning, and I believe many thouſands more.

I have taken no notice of ſeveral fractions in the number of eggs contained in a grain in many caſes, chooſing to fall rather below than to exceed the truth, in all the fiſh I have given an account of in this table. I have been ſcrupulouſly exact in all particulars, excepting what are contained in the ſecond column, which gives the weight of the fiſh I examined, in which the utmoſt nicety was not neceſſary: ſome few might weigh a little more or a little leſs; but all were nearly of the weight ſet down, and much the greateſt part exactly ſo.